RESEARCH ON GRADING METHOD OF COURSES BASED ON ENGINEERING PROFESSIONAL CERTIFICATION

Hua Li [1] | Xuemei Wang [1] | Guoqin Hu [1]

[1] School of chemical and energy Engineering, Zhengzhou University, Zhengzhou 450001, China.

ABSTRACT

In order to meet the requirements of engineering education professional certification, to ensure the engineering teaching quality and promote the teaching ability, the grading method of courses based on engineering professional certification is preliminary explored. The statistic method of analyzing the scores for achievement is applied for the proper evaluation of the test questions. The results show that the traditional methods of evaluation exit shortcomings. A comprehensive method to evaluate the students' course tests by combining the indexes of difficulty, distinction, effectiveness, feasibility and score distribution are proposed, a typical example is provided as an illustration.

KEYWORDS: engineering education; professional certification; the test questions; statistic method.

1. INTRODUCTION:

Examination plays an important role in the teaching process, and its main purpose is to evaluate the degree and level of the knowledge to learn, understand and master for students, as well as an important method to test the teaching quality and existing problems for teachers, which can be used to improve the teaching methods, teaching quality and promote the development the students' quality. Grade evaluation is the baton of the teaching process, which not only commands the teacher's "teaching", but also commands the students' "learning", which plays a vital role in the teaching effect and the quality of talent training. With the development of the project education professional certification, the professional certification has put forward the specific requirements for the student academic performance evaluation. Therefore, in the context of professional certification, it is of great significance to establish a reasonable evaluation system for course performance combined with the actual situation of the school. In this paper, based on the problems in the grade evaluation of traditional course, the mathematical statistics method is used to quantitatively calculate the difficulty, differentiation, test paper feasibility and effectiveness, so as to analyze and evaluate the test paper objectively, accurately and quantitatively, which can more effectively test the students' learning level and the teacher's teaching effect, which also truly reflect the completion of the teaching program and the achievement of the course objectives [1-4]. At the same time, taking into account the fairness, rationality and operability of the evaluation, in this paper, the method of "comprehensive examination of difficulty, differentiation, effectiveness, feasibility and score distribution" was put forward to evaluate students' course score. In our school, the test score analysis of curriculum includes score at ordinary times, final term exam grade and comprehensive curriculum grade. they all were analyzed in degree of difficulty, differentiation, feasibility and effectiveness.

2. GRADING METHOD OF COURSES:

2.1 Difficulty analysis (P):

Difficulty is the degree of difficulty in examining test questions or test papers, which is one of the main indexes to evaluate the quality of examination papers.

(1) Calculated method:

Assume: P is the difficulty factor of the test paper, $\overline{X}$ is the average score of the test paper, and W is the full score of the test paper, then the difficulty of the test paper is:

$$P = 1 - \frac{\overline{X}}{W} \tag{1}$$

Suppose: P_i is the difficulty factor of question i in the test paper, $\overline{X}_i$ is the average score of the question i for all students, W_i is the full score of the question i, then the difficulty of question I is:

$$P_i = 1 - \frac{\overline{X}_i}{W_i} \tag{2}$$

(2) Criteria of judgement:

The closer the difficulty factor is tend to 0, the smaller the difficulty; the closer the difficulty factor is tend to 1, the greater the difficulty.

When $P \leq 0.2$, the difficulty is too low;

When $0.2 < P \leq 0.4$, the difficulty is moderate;

When $0.4 < P < 0.8$, it means that it is more difficult;

When $P \geq 0.8$, the difficulty is too high.

2.2 Differentiation analysis (D):

Differentiation is the degree of differentiation or identification ability of examination questions or test papers to the students' actual level of knowledge. Examination questions or papers, with high degree of differentiation, which can distinguish students with different knowledge levels and abilities, so that students with higher abilities have higher scores, and students with lower abilities have lower scores; test questions or test papers of low differentiation can not distinguish the abilities and levels of knowledge of the students.

(1) Calculated method:

Firstly, the students' test scores of question i are sequenced in order from high to low, taking the top 27% of the students as high grade group, while the bottom 27% are selected as the low grade group. Students' average scores of the question i in the high and low grade group are calculated as $\overline{X}_{ih}$ and $\overline{X}_{il}$ respectively.

If the full score of question i is W_i, then differentiation of question i is

$$D_i = \frac{\overline{X}_{ih} - \overline{X}_{il}}{W_i} \tag{3}$$

Similarly, the average grade of the top 27% of the high-grade group is set as $\overline{X}_h$, the average grade of the bottom 27% of the low- grade group is set as $\overline{X}_l$, and full score of the test paper is W, then differentiation of the test paper is

$$D = \frac{\overline{X}_h - \overline{X}_l}{W}. \tag{4}$$

(2) Criteria of judgement:

When $D > 0.4$, the differentiation is "excellent";

When $0.3 \leq D \leq 0.4$, the differentiation is "good";

When $0.2 \leq D \leq 0.3$, the differentiation is "OK";

When $D < 0.2$, the differentiation is "poor".

2.2 Feasibility analysis(B):

Feasibility is an indicator to measure the feasibility and stability of test questions. High feasibility indicates that students' scores are not easily affected by the errors caused by accidental factors, and the candidate's score can truly reflect the actual level of students.

(1) Calculation formula:

The feasibility B of the examination paper is:

$$B = \frac{n}{n-1} \times \left(1 - \frac{\sum_{i=1}^{n} S_i^2}{S^2}\right) \tag{5}$$

Among them, n represents the total number of questions, Si indicates the standard deviation of question i, and S_2 represents the variance of test papers.

$$S_i = \sqrt{\frac{\sum_{j=1}^{n}(X_{ij} - \bar{X}_i)^2}{m-1}} \tag{6}$$

Among them, m indicates the number of students, and X_{ij} indicates the score of question i of j student, indicates the average score of all students' questions i.

$$S^2 = \frac{\sum_{j=1}^{m}(X_j - \bar{X})^2}{m-1} \tag{7}$$

Among them, m is the number of students and X_j is the total score of test paper of j student, indicates the average score of test papers of all students.

(2) Criteria of judgement:
When B<0.5, the feasibility of test questions is "poor";

When 0.5≤B≤0.8, the feasibility of test questions is "good";

When B>0.8, the feasibility of test questions is "very good".

2.4 Effectiveness analysis (R):
Effectiveness is an index to measure the degree of achievement of test objectives, which reflects the accuracy and effectiveness of the test. In order to improve the effectiveness of the examination, two kinds of questions should be paid attention: firstly, the goal of the examination should be clear, it is to test the ability to master basic knowledge for students, or to test the students' ability to apply knowledge for judgment, or a combination of both; secondly, the design of the test questions should be able to effectively reflect the test objectives, in which the objective test questions are generally used to assess students' mastery of basic knowledge, while the non-objective test questions are used to assess students' ability to apply knowledge for judgment.

(1) Calculation formula:
The effectiveness of the test paper can be measured by the average differentiation of the test paper, thus:

$$R = \frac{\sum_{i=1}^{n} D_i}{n} \tag{8}$$

Among them, R is the effectiveness of the test paper, D_i is differentiation of question i, and n is the total number of test questions.

(2) Criteria of judgement:
When R≥0.4, the effectiveness of the test paper is good, that is, the goal of the assessment can be effectively achieved.

Taking the course of pharmaceutical separation engineering in our school as an example, the evaluation result of examination paper is illustrated, which includes the analysis of test score and test quality. Analysis of test score also includes the problems found and the improvement actions except the average score and frequency distribution chart. The quality analysis of the test questions includes the difficulty, differentiation, feasibility and effectiveness.

(1) Evaluation of test results:
In this test, the highest score is 96, the lowest score is 45, and the average score is 76.8, of which 2 students failed the final exam, and the pass rate reaches 96.4%. The percentage distribution of each fraction is shown in Figure 1, and the distribution of the test results is shown in Figure 2. There is a 51-point gap between the highest score and the lowest score, which shows that the students with good learning ability and poor learning ability have great differences in their grades. Teachers should pay more attention to the students with poor learning ability in future teaching.
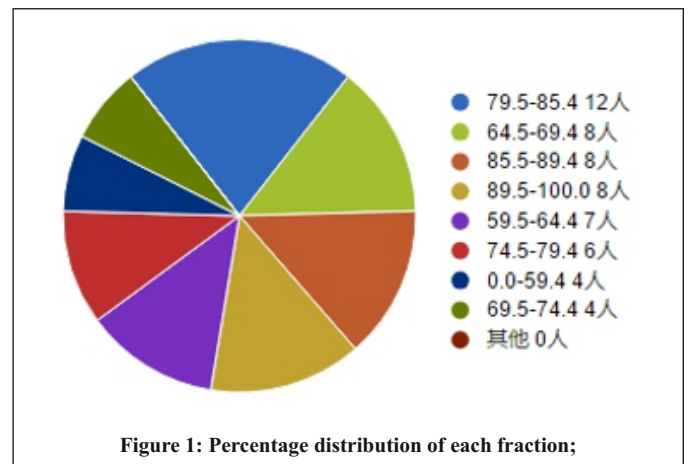

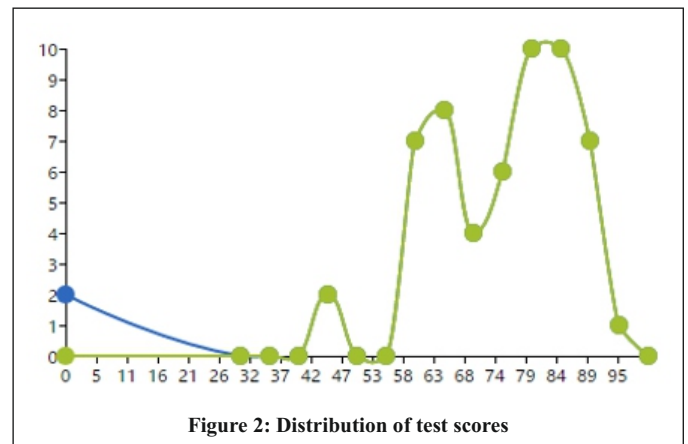**Figure 1: Percentage distribution of each fraction;**

Figure 2: Distribution of test scores

(2) Evaluating the quality of test papers:
The total score of this paper is 100, which includes 3 Question Type, that is filling blanks (50 questions, 50 points), discussion questions (6 questions, 30 points), design questions (2 questions, 20 points), respectively, and the proportion of each type is shown in Table 1.

Table 1: Distribution of test questions in pharmaceutical separation engineering

	Question types	Number of Question	Score	Percentage
Objective question	Filling blanks	50	50	50%
Subjective question	Discussion questions	6	30	30%
	Design questions	2	20	20%
Total		58	100	100%

In this test, the content of the questions is relatively extensive, which overwrites most of all existing difficulties and key points in the textbooks, which can not only test the degree of master knowledge, but also evaluate the comprehensive understanding and application of knowledge for students.

As an important parameter for evaluating the quality of test papers, such as difficulty analysis, differentiation analysis, effectiveness analysis, feasibility analysis, which is also an important basis for evaluating the effectiveness and feasibility of score. Overall, the average difficulty of this test paper is 0.44, which is consistent with the other test papers of 0.40 - 0.80 of P value; the differentiation is 0.46, indicating that the quality of the test paper is good; the feasibility is 0.6875, which reflects the size of the random error in the test; the validity is 0.5236, which also reflects the size of system error in the test.

3. CONCLUSION:
Engineering education professional certification puts forward higher requirements for the test evaluation system. Effective test analysis can objectively reflect the teaching level and effect, which can help teachers and students to find teaching bottleneck problem, improving our teaching method and teaching quality. An exam is a measurement, in order to improve the accuracy of measurement, it is necessary to use scientific measurement theory, appropriate measurement tools and scientific quantitative evaluation index to analyze the test paper. Any method of course evaluation has its advantages and disadvantages. Only based on the full understanding of various methods, our own advantages can be kept in the course evaluation reform. By learning from the experience of universities at home and abroad rationally, learning from other's strong points to make up our

deficiencies, our grading method of courses can be beneficial to promote comprehensive and the well-rounded development of student.

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